INSTRUCTIONS

FOR THE

NATIONAL TYPES

NC-300C1, NC-300C2, NC-300C6A, NC-300CC

CONVERTERS AND CABINET

GENERAL DESCRIPTION

The NC-300 Converters are of the broad-band, crystal-controlled type. The output (IF) frequency is 30 to 35 megacycles to correspond to the X band frequency of the National type NC-300 receiver. The slide rule dial of the NC-300 incorporates three separate dial scales to provide direct-reading frequency calibration when the converters are used with this receiver. In addition, all operating voltages required by the converters are available at the accessory socket of the NC-300. If desired, the converters may be used with any receiver which will tune the frequency range of 30 to 35 megacycles. In this case, power for the heaters and plates may be provided from any source capable of furnishing 6.3 volts ac at 1.2 amperes and 100-150 volts at 25 ma. for each converter.

The following is a list of the converters available and their frequency coverage.

Type	Amateur Band	Frequency Range
NC-300C1	1-1/4 meters	220-225 mc
NC-300C2	2 meters	143.5-148.5 mc
NC-300C6	6 meters	50-54 mc

The antenna input impedance is 50-75 ohms unbalanced to match coax-fed systems. For optimum performance an antenna designed for each amateur band should be used. This would preferably be the antenna normally used for transmitting.

To provide uniform gain over the entire amateur band and to provide the desired low noise figure, the NC-300C1 and NC-300C2 converters each use two stages of RF amplification. In both units a 6BZ7 dual triode is used in a cascode circuit, followed by a 6AK5 pentode. The triode section of a 6U8 is used as a crystal oscillator and the pentode section serves as an amplifier-multiplier. A second 6AK5 pentode is used as a mixer. In the NC-300C6A a 6CB6 provides a single stage of RF amplification. The triode section of a 6U8 is connected as a crystal oscillator and the pentode section of this tube is used as an amplifier-mixer.

NATIONAL COMPANY, INC., EST. 1914 MALDEN & MELROSE, MASS.

The National NC-300 Converter Cabinet is designed to provide a convenient and attractive means of mounting the converters. From one to three converters may be mounted in the cabinet which matches the receiver cabinet and is similar in size and appearance with the NC-300 speaker cabinet. A four-position switch is mounted on the front panel to permit operation of the main receiver or any one of the three converters without changing connections to the receiver or antenna.

The cabinet is primarily intended for use with the NC-300 receiver and, for this reason, is equipped with three-foot long power and output cables terminated with connectors to fit the accessory socket and converter input jack of the NC-300. If operation with receivers other than the NC-300 is desired, these connectors may be removed or replaced with connectors applicable to the installation requirements.

Since the band switch connects power to only one converter at a time, the power requirements of a complete three-band installation are the same as for one converter, i.e.: 100-150 volts at 25 ma. and 6.3 volts at 1.2 amperes.

The NC-300 Converters, as shipped from the factory, are complete with tubes, crystal, connecting cords and plugs. To provide installation flexibility, the octal power plug and RF output plug are not connected. Any one of the following three methods may be employed to make the initial connections:

INSTALLATION IN CONVERTER CABINET

Installation of the NC-300CC Converter Cabinet consists of mounting the individual converters within the cabinet, making the required electrical connections to the band switch and making the connections between the cabinet and the receiver. This is accomplished in the following manner:

Step 1. Remove the front panel of the cabinet by removing the four chrome-plated acorn nuts and pushing the panel off the mounting studs from the rear.

Step 2. Remove the dust covers from the converters by removing the four 6-32 screws around the top edge of each converter. Do not discard the screws.

Step 3. Locate the converter (s) in the cabinet. Facing the front of the cabinet the proper sequence is, from left to right, 1-1/4, 2 and 6-meter units. The underside of the converters should face the front of the cabinet with the power leads at the top.

Step 4. Secure the converters to their mounting bracket using the four 6-32 screws removed in Step 2.

Step 5. Cut the power leads of the converters to a length of 10 inches and the coax leads to 9 inches.

Step 6. On the red and brown power leads cut back the outer insulation for approximately 1-1/4 inches, form a pigtail of the shield braid, bare and tin the end of the inner conductor.

Step 7. On the coax output leads, cut the outer insulation approximately one inch from the end. Cut the shield braid to leave approximately 1/8 inch of exposed braid. Remove 1/4 inch of insulation from the inner conductor and tin the conductor.

Step 8. A piece of tinned bus wire and a length of insulated sleeving is attached to the ground lug underneath the large standoff insulator next to the bandswitch. Place the bared shield braid of the coax cables together and wrap with the end of the bus wire, removing some of the sleeving if necessary. Solder this joint being careful not to melt the insulation of the coax.

Step 9. Solder the inner conductors of the coax to the band switch as shown on Figure 1.

Step 10. Feed the power cables through the metal loop located at the underside of the cabinet top. Solder the inner conductors of the brown leads to the switch and the inner conductors of the red leads to the terminal strip as illustrated on Figure 1.

Step 11. Connect the braided shields of the power leads to the nearest ground points as illustrated on Figure 1.

Step 12. Replace the front panel and secure with the four acorn nuts.

Step 13. Plug the octal power plug into the accessory socket of the NC-300 and plug the output phone-type plug into the Converter Input jack.

Step 14. Connect the 1-1/4, 2 and 6-meter antenna lead-ins to the respective antenna jacks on the rear of the converters.

The converters are now ready to operate.

INSTALLATION WITH NC-300 BUT LESS CONVERTER CABINET

If the NC-300 Converters are to be used with the NC-300 without the converter cabinet it is necessary to install the plugs on the power and RF cables:

Connect the shield braid of the red and brown leads to pin 6 of the octal plug.
Connect the inner conductor of the red lead to pin 8.
Connect the inner conductor of the brown lead to pin 7.
Connect the inner conductor of the black coax to the center pin of the phono type plug.
Connect the shield braid of the black coax to the shell of the phone type plug.

The length of the cables may be altered to suit the installation requirements without affecting operation. Insert the octal plug into the NC-300 accessory socket and the phono-type plug into the Converter Input jack. Connect the coax lead-in from a 50-75-ohm antenna to Antenna jack J1 of the converter using a phono-type plug.

INSTALLATION WITH RECEIVER OTHER THAN NC-300

When used with receivers other than the NC-300 it is not necessary to use the octal or the phono-type plug. Connect the shield braid of the red, brown and black leads to the receiver chassis. Connect the red lead to a source of 100-150 volts dc. Connect the brown lead to 6.3 volts ac at 1.2 amperes. Connect the inner conductor of the black coax to the receiver antenna terminal. Remove any external antenna leads from the receiver and connect the antenna lead-in to converter antenna jack J1.

The receiver must be capable of tuning the 30-35 megacycle range.

OPERATION

After completing all connections, set the operating controls of the receiver for the desired mode of operation. When the NC-300 receiver is used, set the Band switch at the position corresponding to the converter in use. In addition, if the converter cabinet is used, set the cabinet Band switch at the same position. If other than the NC-300 receiver is used, set the receiver band selector at the 30-35 mc. band.

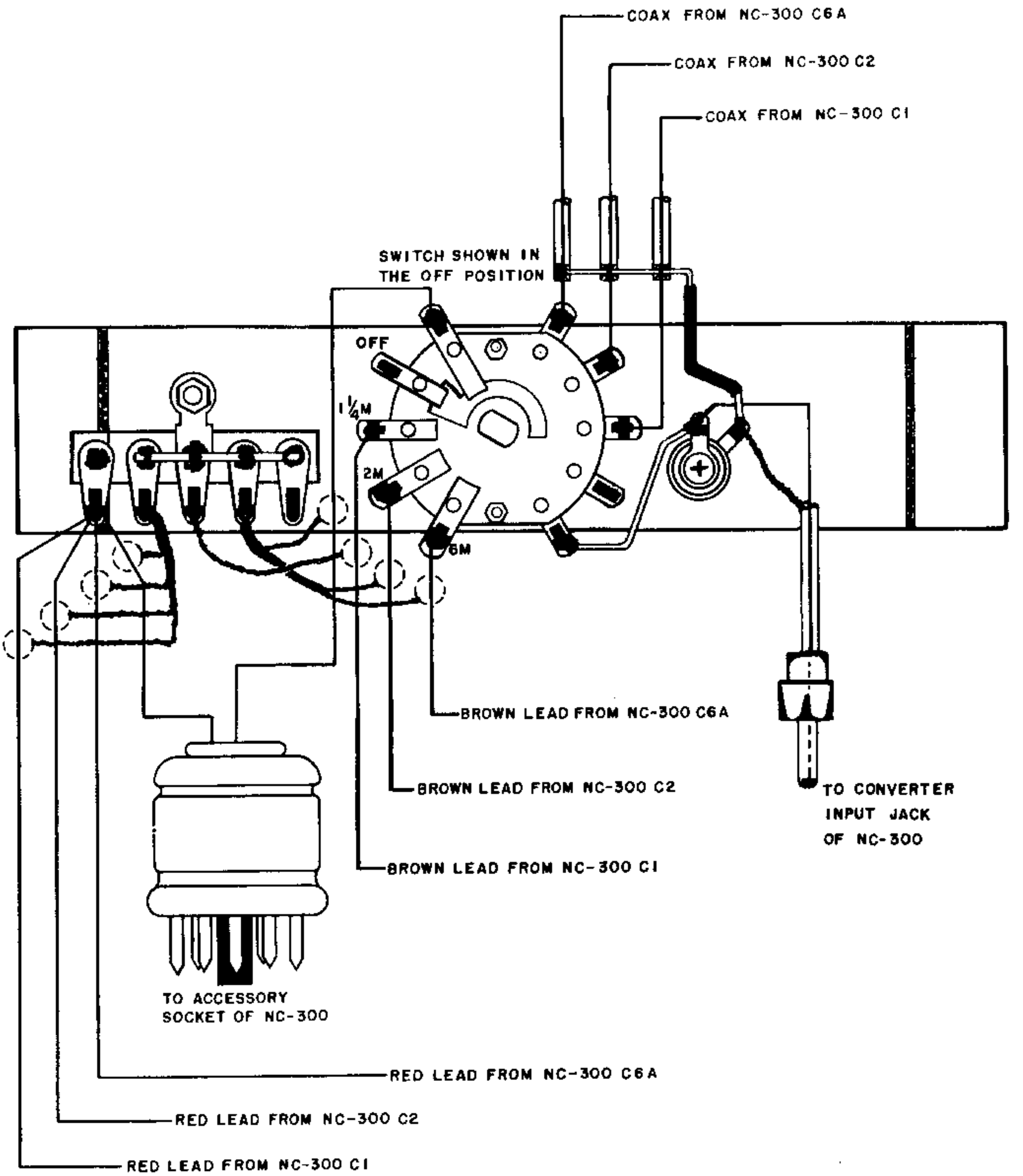


Figure 1. Converter Cabinet, Wiring Diagram

REALIGNMENT

In normal operation, converter realignment is seldom required. Before attempting realignment check the receiver, interconnecting cables, and the tubes and components of the converter.

The need for realignment is evidenced by a consistent lack of signal strength or the inability to receive signals known to be on the air. Realignment should not be attempted without the proper test equipment. Because of the frequency coverage and overall gain involved, these instructions must be followed.

NC-300C6A

The inability to receive known signals indicates that the crystal oscillator has ceased functioning. Tune the receiver to a known signal frequency (signal generator, transmitter, etc). Adjust L6 (Figure 2) to produce a peak on the receiver S meter, L6 will tune sharply on one side of the peak and broadly on the other. Tune L6 slightly off peak on the broad side to insure stable operation.

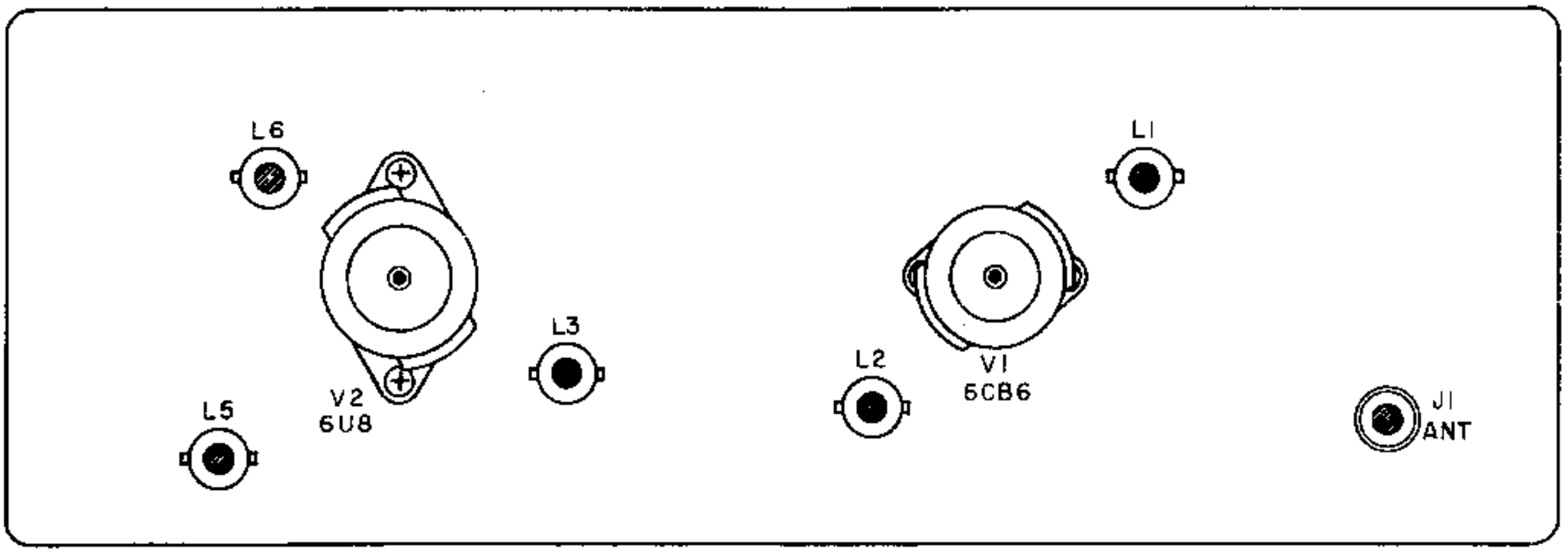


Figure 2. NC-300C6A, Top View

With the oscillator functioning properly, proceed with the RF alignment as follows:

Step 1. Using as short a wire as possible, solder a jumper across coil L5.

Step 2. Connect sweep generator between pin 1 of V1 and ground.

Step 3. Set sweep generator to sweep from 48 mc to 56 mc.

Step 4. Connect Converter output leads to crystal detector input. See Figure 8A. Detector output is connected to oscilloscope.

Step 5. Adjust L6 to prevent oscillation. As the slug is tuned-in the amplitude will rise abruptly indicating that the crystal oscillator has stopped oscillating.

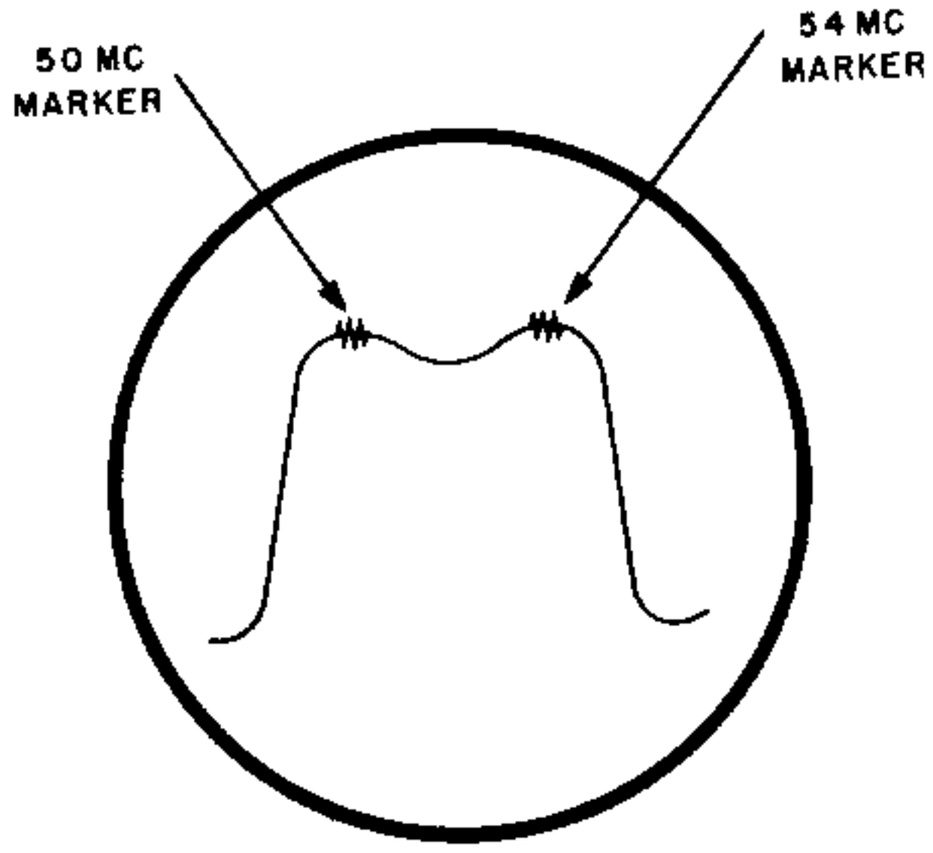
Step 6. Advance sweep generator and oscilloscope gain until a response is observed.

Step 7. Adjust slugs of L3 and L4 for minimum inductance (slugs almost all the way out).

Step 8. Set marker generator to 53.5 mc. Tune slug L2 for maximum output at marker frequency.

Step 9. Set marker generator to 50.5 mc. Tune slug L4 for maximum output at marker frequency.

Step 10. Tune slug L3 to flatten and broaden the response as shown in the figure at the right. Marker generator is used to check peak response points.



Step 11. Connect sweep generator output to J1 (Ant. input).

NOTE: Connect a 47 ohm resistor between J1 and ground. Connect a 220 ohm resistor in series with the sweep generator output lead.

Step 12. Remove jumper from L5. Adjust L6 for oscillation. As the slug is turned out of L6 the amplitude will rise abruptly indicating that the crystal has started oscillating.

Step 13. Set marker generator to 54.5 mc. Adjust L5 for maximum output.

Step 14. Set marker generator to 49.5 mc and adjust L1 for maximum so that the curve appears on the oscilloscope as shown in the above figure.

Step 15. Adjust L3 to correct any tilt using marker generator to indicate band edges at 50 and 54 mc. Final response should be flat or slightly tilted.

Step 16. Remove all test equipment.

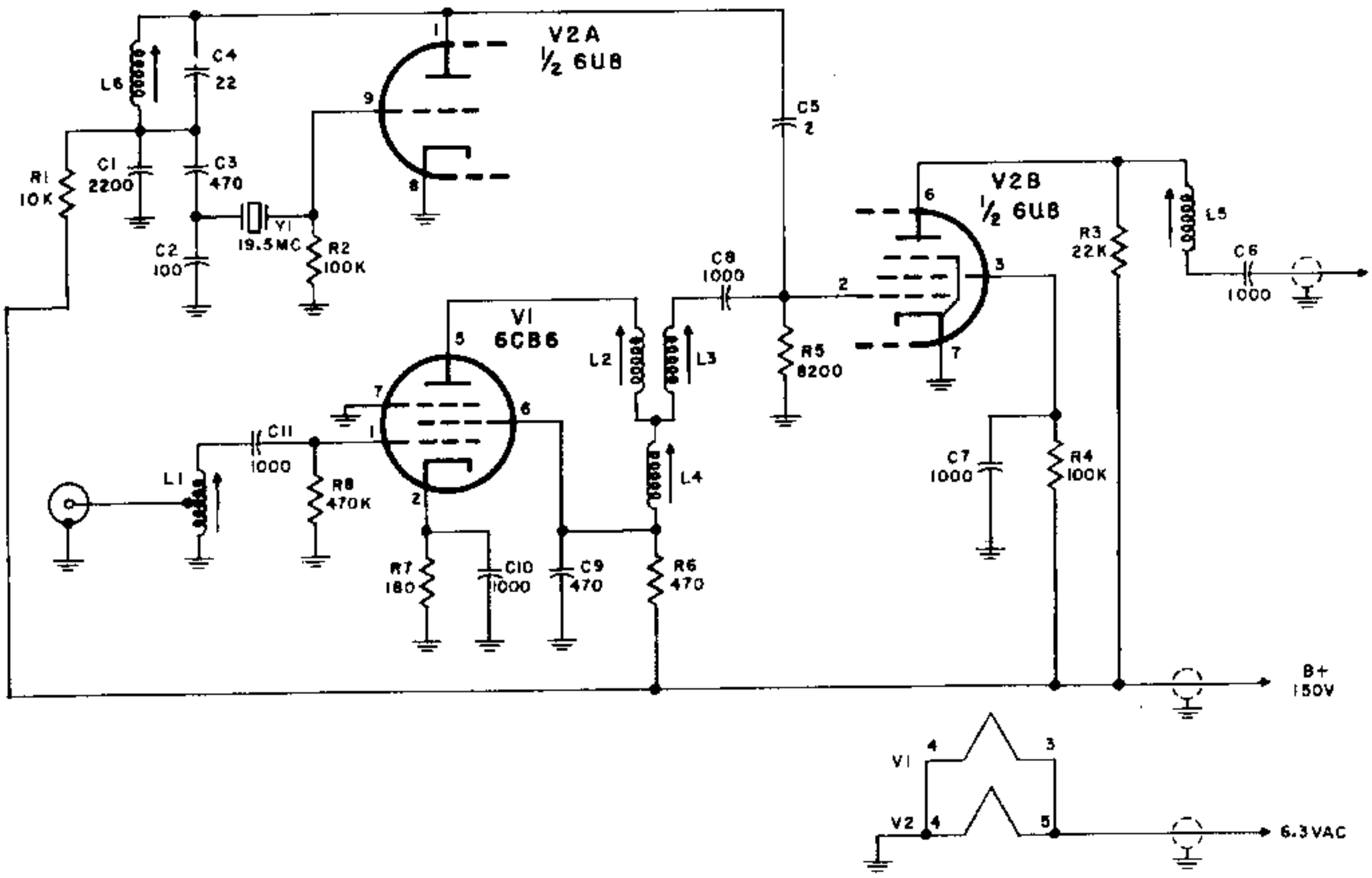


Figure 3. NC-300C6A, Schematic Diagram

Step 1. Set the RF and AF gain controls of the receiver at full gain and tune for a signal of known frequency. This could be from the station transmitter, a signal generator or a signal from a remote transmitter.

Step 2. If the signal is weak, (as indicated by past performance) RF alignment is indicated. If the signal does not appear but there is normal background noise, oscillator alignment is indicated. Lack of signal as well as background noise will require a check of all tubes and components.

Step 3. If oscillator adjustment is indicated, set the receiver at a known signal frequency and adjust L6 on the converter to produce a peak on the receiver S meter. See Figure 4. It will be noted that tuning will be very sharp on one side of the peak and broad on the other. Adjust L6 slightly off resonance on the broad side.

Step 4. Disconnect the antenna from J1 and connect a noise generator in its place. Adjust L7 and L5 to produce maximum noise as indicated by the receiver S meter.

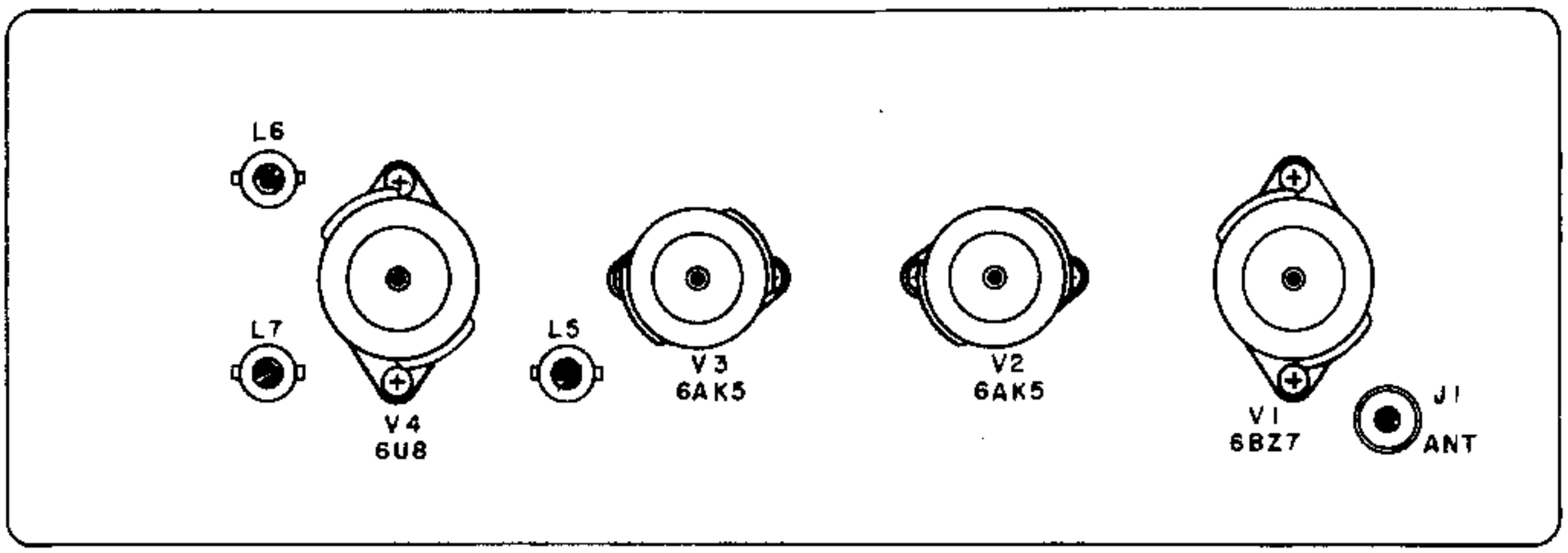


Figure 4. NC-300C2, Top View

Step 5. Disconnect the converter RF output cable from the receiver and connect it to an oscilloscope having an input sensitivity of 25 millivolts or better. Use the rectifier-filter network illustrated on Figure 5A.

Step 6. Remove the noise generator from J1 and connect a sweep generator in its place. The generator should have a sweep range of 10-15 mc. Set the generator center frequency at 146 mc.

Step 7. Lightly couple a marker generator to J1. Use a turn or two of insulated wire or a capacitor of 1-5 $\mu\mu$fd. Set the marker frequency at 147.5 mc.

Step 8. Adjust the sweep controls of the scope to produce a trace as illustrated in Figure 5B.

Step 9. Adjust L3 (the center-tapped air-wound coil connected to pin 1 of V1) to produce maximum amplitude of the scope trace at the marker frequency. This is accomplished by spreading or compressing the turns of L3.

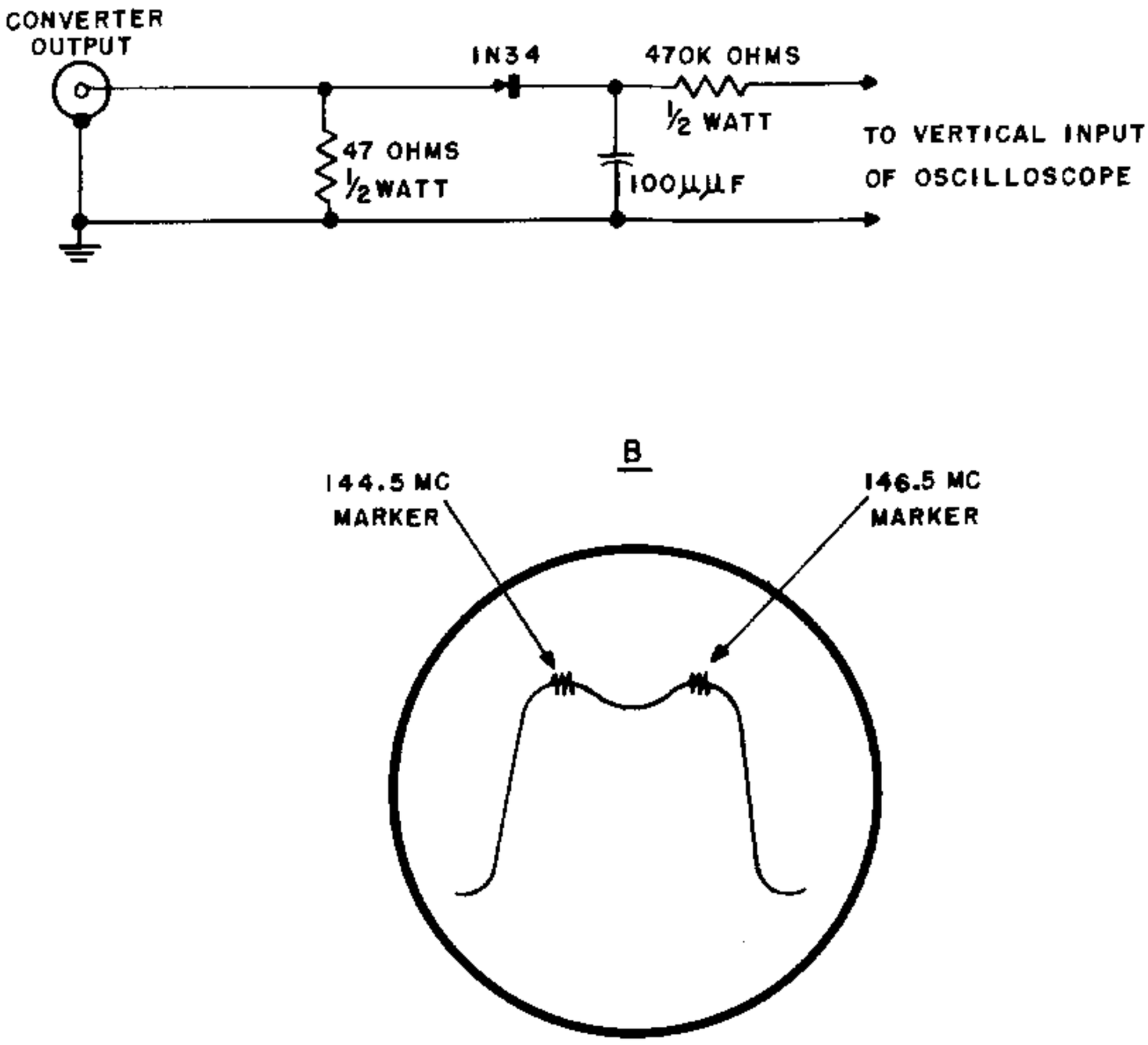


Figure 5. NC-300C2, Rectifier-Filter Network and Scope Pattern

NOTE

When working on the underside of the converter chassis be careful not to disturb the neutralizing bus wire located across the base of the V2 socket.

Step 10. Set the frequency of the marker generator at 144.5 mc. Adjust L4 (the air-wound coil connected to pin 5 of V2) to produce maximum amplitude of the scope trace at the marker frequency.

Step 11. Disconnect the sweep and marker generators and connect a noise generator at J1. Connect an output meter at the speaker terminals of the receiver.

Step 12. Set the receiver at CW, audio gain fully advanced and RF gain sufficient to produce a reading of one milliwatt on the output meter.

Step 13. Raise the output of the noise generator to produce an output of two milliwatts. Read the noise figure on the generator.

Step 14. Adjust L1 and L2 to produce the lowest possible noise figure. Repeat steps 12 and 13 as necessary to insure optimum noise figure readings.

Step 15. Remove all test equipment. Reconnect the RF cable to the receiver and the antenna to J1.

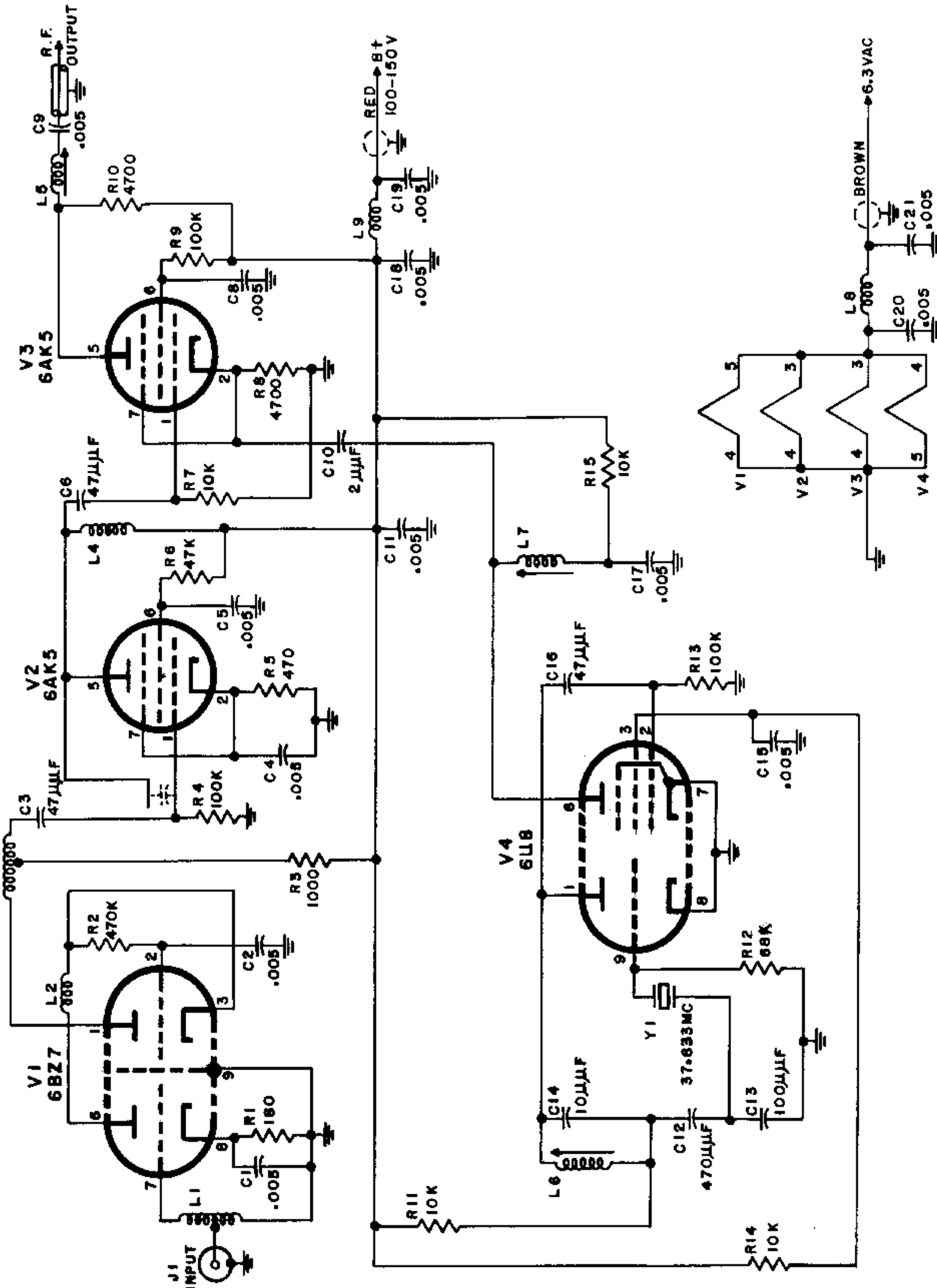


Figure 6. NC-300C2, Schematic Diagram

Step 1. Set the RF and AF gain controls of the receiver at full gain and tune for a signal of known frequency. This could be from the station transmitter, a signal generator or a signal from a remote transmitter.

Step 2. If the signal is weak, (as indicated by past performance) RF alignment is indicated. If the signal does not appear but there is normal background noise, oscillator alignment is indicated. Lack of signal as well as background noise will require a check of all tubes and components and complete realignment.

Step 3. If oscillator adjustment is indicated, proceed with steps 4 through 9.

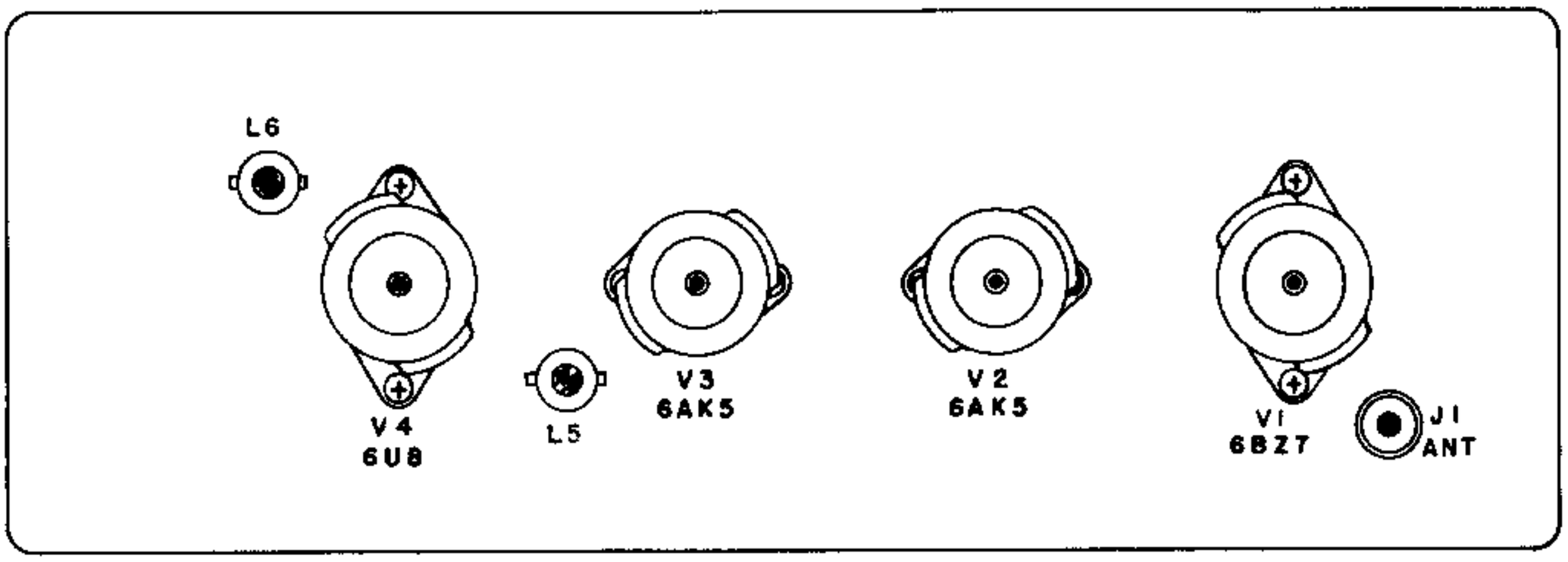


Figure 7. NC-300C1, Top View

Step 4. Disconnect the antenna from J1 and lightly couple a marker generator to the converter. This can usually be done quite effectively by connecting the marker generator to the chassis near the input.

Step 5. Disconnect the converter RF output cable from the receiver and connect it to an oscilloscope through the rectifier-filter network shown as Figure 8A. The oscilloscope should have an input sensitivity of 25 millivolts or better.

Step 6. Connect a sweep generator between pin 2 of V1 and chassis. The generator should have a sweep range of 10-15 mc around a center frequency of 222 mc.

Step 7. Disconnect L1 at the point of connection to C1.

Step 8. Advance the sweep generator output and oscilloscope gain until a response is observed.

Step 9. Adjust L6 for maximum output. As the tuning slug is turned into the coil the amplitude will drop abruptly indicating that the crystal oscillator has stopped oscillating. As the tuning slug is turned out of the coil the amplitude will drop slowly. Maximum output occurs at the point where the crystal stops oscillating. The correct setting of the tuning slug is just slightly out from the non-oscillating point.

Step 10. Adjust L5 and L7 for maximum output.

Step 11. Short circuit L5 by connecting a jumper across it.

Step 12. Set the marker generator at 218 mc. Adjust L3 for maximum output at the marker frequency.

Step 13. Set the marker generator at 227 mc. Adjust L4 for maximum output at the marker frequency.

Step 14. Set the marker generator at 222.5 mc. The scope display should now indicate the response shown on Figure 8B. Coils L3 and L4 may be adjusted slightly to obtain this response. These are air-wound coils and are adjusted by carefully

spreading or compressing the turns. L3 is connected to pin 6 of V1 and L4 is connected to pin 5 of V2.

Step 15. Move the sweep generator to connect to converter input jack J1. Resolder the end of L1 previously disconnected.

Step 16. Set the marker generator at 217 mc. Adjust L1 and L2 for maximum gain at the marker frequency. The scope display should resemble Figure 8C.

Step 17. Remove the shorting jumper from L5. Set the marker generator at 225 mc. Adjust L5 for maximum response at the marker frequency. The scope display should correspond to Figure 8D.

Step 18. Tune L4 lower in frequency to broaden the response as required using the marker generator to indicate band edges at 220 and 225 mc. Final response should resemble Figure 8E.

Step 19. Remove all test equipment and reconnect the RF cable to the receiver and the antenna to J1.

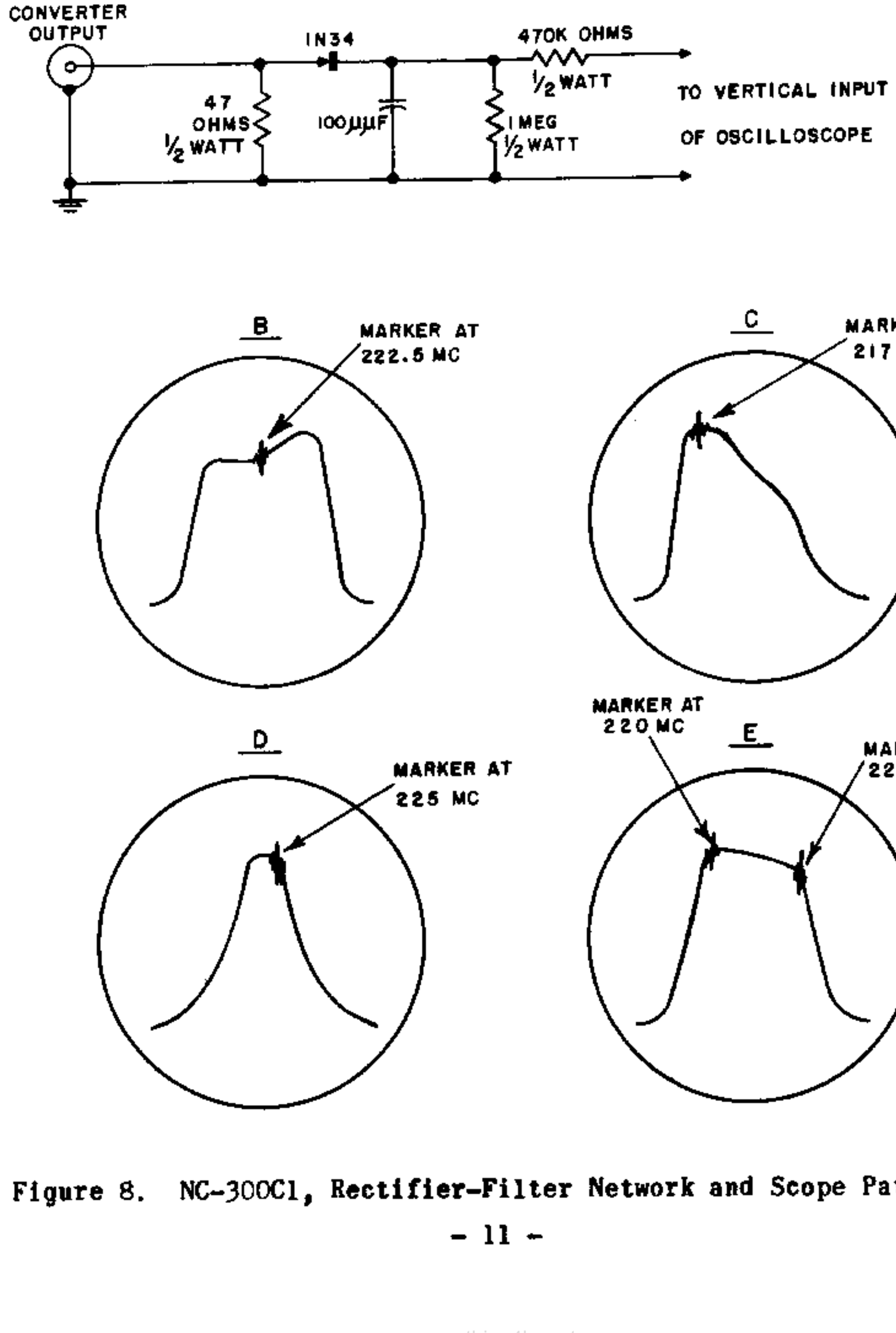


Figure 8. NC-300C1, Rectifier-Filter Network and Scope Patterns

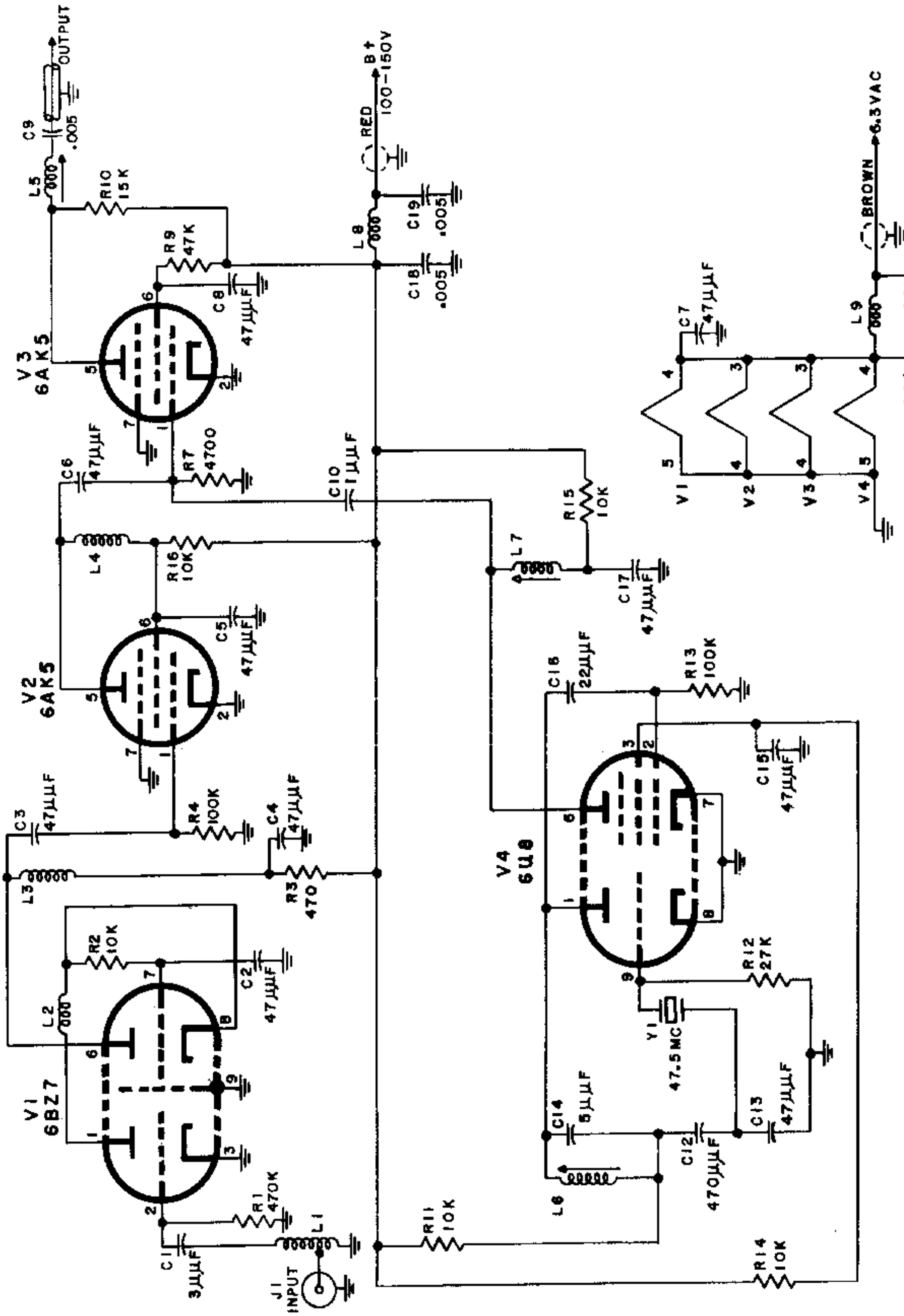


Figure 9. NC-300C1, Schematic Diagram

NC-300C6A PARTS LIST

Symbol No.	Description	Part No.
C1	Capacitor: ceramic, 22 μμfd 20% 500 vdcw	2-C14-Z5S-222M
C2	Capacitor: fixed, mica, 100 μμfd ±10% 500 vdcw	NCS-15-101-K-5
C3	Capacitor: ceramic, 470 μμfd ±10%	2-C61-Z5P-471K
C4	Capacitor: mica, 22 μμfd ±10%	NCS-15-220-K-5
C5	Capacitor: mica, 2 μμfd 5%	NCS-15-020-J-5
C6	Capacitor: ceramic, 1000 μμfd, GMV	2-C11-Z5V-102-GMV
C7	Same as C6	
C8	Not used	
C9	Same as C6	
C10	Same as C6	
J1	Jack: phono-type	Natco T458-1
L1	Coil: RF, iron core tuning	Natco 300013
L2	Coil: RF, iron core tuning	Natco 300014
L3	Coil: RF, iron core tuning	Natco 300015
L4	Same as L2	
L5	Coil: RF, air wound	Natco 300016
L6	Coil: RF, iron core tuning	Natco 300017
P1	Plug: male, octal	Amphenol 86-PM8
P2	Plug: coaxial, phono-type	Natco T828-1
R1	Resistor: fixed, composition, 10,000 ohms, 1/2 watt, ±10%	RC20BF103K
R2	Resistor: fixed, composition, 100,000 ohms, 1/2 watt, ±10%	RC20BF104K
R3	Resistor: fixed, composition, 22,000 ohms, 1/2 watt, ±10%	RC20BF223K
R4	Same as R2	
R5	Resistor: fixed, composition, 8200 ohms, 1/2 watt, ±10%	RC20BF822K
R6	Resistor: fixed, composition, 470 ohms, 1/2 watt, ±10%	RC20BF471K
R7	Resistor: fixed, composition, 180 ohms, 1/2 watt, ±10%	RC20BF181K
R8	Resistor: fixed, composition, 470,000 ohms, 1/2 watt, ±10%	RC20BF474K
V1	Electron tube	6CB6
V2	Electron tube	6U8
Y1	Crystal: quartz, frequency - 19.5 mc	Midland ML-6W

NC-300C2 PARTS LIST

Symbol No.	Description	Part No.
C1	Capacitor: fixed, ceramic, .005 μf, +100% -0%, 500 vdcw	Natco K946-1
C2	Same as C1	
C3	Capacitor: fixed, ceramic, 47 μμfd, ±20%, 500 vdcw	Natco K946-19
C4	Same as C1	
C5	Same as C1	
C6	Same as C3	
C7	Not used	
C8 and C9	Same as C1	
C10	Capacitor: fixed, mica, 2 μμfd, ±5%, 500 vdcw	Electromotive DM15C020J
C11	Same as C1	
C12	Capacitor: fixed, mica, 470 μμfd, ±10%, 300 vdcw	CM20B471K
C13	Capacitor: fixed, mica, 100 μμfd, ±10%, 500 vdcw	Electromotive DM15C101K
C14	Capacitor: fixed, mica, 10 μμfd, ±10%, 500 vdcw	Electromotive DM15C100K
C15	Same as C1	
C16	Same as C3	
C17 thru C21	Same as C1	
J1	Jack: phono-type	Natco T458-1
L1	Coil: RF, air wound	Natco 300019
L2	Coil: RF, air wound	Natco 300020
L3	Coil: RF, air wound	Natco 300021
L4	Coil: RF, air wound	Natco 300022
L5	Coil: RF, iron core tuning	Natco 300017
L6	Coil: RF, iron core tuning	Natco 300014
L7	Coil: RF, iron core tuning	Natco 300023
L8	Coil: RF choke	Natco 300036
L9	Coil: RF choke, 750 mh	Natco SA:2868
P1	Plug: male, octal	Amphenol 86-PM8
P2	Plug: coaxial, phono-type	Natco T828-1
R1	Resistor: fixed, composition, 180 ohms, 1/2 watt, ±10%	RC20GF181K
R2	Resistor: fixed, composition, 470,000 ohms, 1/2 watt, ±10%	RC20GF474K
R3	Resistor: fixed, composition, 1,000 ohms, 1/2 watt, ±10%	RC20GF102K
R4	Resistor: fixed, composition, 100,000 ohms, 1/2 watt, 10%	RC20GF104K
R5	Resistor: fixed, composition 470 ohms, 1/2 watt, ±10%	RC20GF471K
R6	Resistor: fixed, composition, 47,000 ohms, 1/2 watt, ±10%	RC20GF473K
R7	Resistor; fixed, composition 10,000 ohms, 1/2 watt, ±10%	Natco J569-37
R8	Resistor: fixed, composition, 4700 ohms, 1/2 watt, ±10%	RC20GF472K
R9	Same as R4	

NC-300C2 PARTS LIST (Cont'd)

Symbol No.	Description	Part No.
R10	Same as R8	
R11	Same as R7	
R12	Resistor: fixed, composition, 68,000 ohms, 1/2 watt, ±10%	RC20GF683K
R13	Same as R4	
R14	Same as R7	
R15	Same as R7	
V1	Electron tube	6BZ7
V2	Electron tube	6AK5
V3	Same as V2	
V4	Electron tube	6U8
Y1	Crystal: quartz, frequency - 37.833 mc.	Midland ML-6W

NC-300C1 PARTS LIST

C1	Capacitor: fixed, ceramic, 3 μμf, ±10%, 500 vdcw	Natco D825D-477
C2	Capacitor: fixed, ceramic, 47 μμfd, ±20%, 500 vdcw	Natco A14975-12
C3	Same as C2	
C4	Same as C2	
C5	Same as C2	
C6	Same as C2	
C7	Same as C2	
C8	Same as C2	
C9	Capacitor: fixed, ceramic, .005 μf, +100% -0%, 600 vdcw	Natco A14975-2
C10	Capacitor: fixed, ceramic, 1 μμfd, ±10%, 500 vdcw	Natco D825D-479
C11	Not used	
C12	Capacitor: fixed, mica, 470 μμfd, ±10%, 300 vdcw	CM20B471K
C13	Same as C2	
C14	Capacitor: fixed, ceramic, 5 μμfd, ±10%, 500 vdcw	Natco D825D-480
C15	Same as C2	
C16	Capacitor: fixed, ceramic, 22 μμfd, ±10%, 500 vdcw	Natco D825D-478
C17	Same as C2	
C18 thru C21	Same as C9	
J1	Jack: phono-type	Natco A11998
L1	Coil: RF, air wound	Natco B16971-1
L2	Coil: RF, air wound	Natco B16971-2
L3	Coil: RF, air wound	Natco B16971-3
L4	Coil; RF, air wound	Natco B16971-4
L5	Coil: RF, iron core tuning	Natco B16978-1
L6	Coil: RF, iron core tuning	Natco B16978-2
L7	Coil: RF, iron core tuning	Natco B16971-5
L8	Coil: RF choke	Natco B16972
L9	Coil: RF choke, 750 mh	Natco SA:2868

NC-300C1 PARTS LIST (Cont'd)

Symbol No.	Description	Part No.
P1	Plug: male, octal	Natco J823-1
P2	Plug: coaxial, phono-type	Natco T828-1
R1	Resistor: fixed, composition, 470,000 ohms, 1/2 watt, ±10%	RC20BF474K
R2	Resistor: fixed, composition, 10,000 ohms, 1/2 watt, ±10%	RC20BF103K
R3	Resistor: fixed, composition 470 ohms, 1/2 watt, ±10%	RC20BF471K
R4	Resistor: fixed, composition 100,000 ohms, 1/2 watt, ±10%	RC20BF104K
R5	Not used	
R6	Not used	
R7	Resistor: fixed, composition, 4700 ohms, 1/2 watt, ±10%	RC20BF472K
R8	Not used	
R9	Resistor: fixed, composition, 47,000 ohms, 1/2 watt, ±10%	RC20BF473K
R10	Resistor: fixed, composition, 15,000 ohms, 1/2 watt, ±10%	RC20BF153K
R11	Same as R2	
R12	Resistor: fixed, composition, 27,000 ohms, 1/2 watt, ±10%	RC20BF273K
R13	Same as R4	
R14, R15	Same as R2	
R16	Resistor: fixed, composition, 10,000 ohms, 1 watt, ±10%	RC30GF103K
V1	Electron tube	6BZ7
V2	Electron tube	6AK5
V3	Same as V2	
V4	Electron tube	6U8
Y1	Crystal: quartz frequency - 47.5 mc.	Natco A16992

NC-300 CONVERTER CABINET PARTS LIST

P1	Plug: male, octal	Amphenol 86-PM8
P2	Plug: coaxial, phono-type	Natco T828-1
S1	Switch: rotary, two pole, 4 position, phenolic insulation	Natco 300052